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UTILIZATION OF MAGNETIC FIELDS DURING COLORING OF CELLULOSE AND POLYESTER FIBER FABRICS

by

O.I. Konstantinov, B.N. Melnikov, et al.



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# U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

| Block | Italic | Transliteration | Block | Italic | Transliteration |
|---|---|---|---|---|---|
| А а | *А а* | A, a | Р р | *Р р* | R, r |
| Б б | *Б б* | B, b | С с | *С с* | S, s |
| В в | *В в* | V, v | Т т | *Т т* | T, t |
| Г г | *Г г* | G, g | У у | *У у* | U, u |
| Д д | *Д д* | D, d | Ф ф | *Ф ф* | F, f |
| Е е | *Е е* | Ye, ye; E, e* | Х х | *Х х* | Kh, kh |
| Ж ж | *Ж ж* | Zh, zh | Ц ц | *Ц ц* | Ts, ts |
| З з | *З з* | Z, z | Ч ч | *Ч ч* | Ch, ch |
| И и | *И и* | I, i | Ш ш | *Ш ш* | Sh, sh |
| Й й | *Й й* | Y, y | Щ щ | *Щ щ* | Shch, shch |
| К к | *К к* | K, k | Ъ ъ | *Ъ ъ* | " |
| Л л | *Л л* | L, l | Ы ы | *Ы ы* | Y, y |
| М м | *М м* | M, m | Ь ь | *Ь ь* | ' |
| Н н | *Н н* | N, n | Э э | *Э э* | E, e |
| О о | *О о* | O, o | Ю ю | *Ю ю* | Yu, yu |
| П п | *П п* | P, p | Я я | *Я я* | Ya, ya |

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

## RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

| Russian | English | Russian | English | Russian | English |
|---|---|---|---|---|---|
| sin | sin | sh | sinh | arc sh | $\sinh^{-1}$ |
| cos | cos | ch | cosh | arc ch | $\cosh^{-1}$ |
| tg | tan | th | tanh | arc th | $\tanh^{-1}$ |
| ctg | cot | cth | coth | arc cth | $\coth^{-1}$ |
| sec | sec | sch | sech | arc sch | $\mathrm{sech}^{-1}$ |
| cosec | csc | csch | csch | arc csch | $\mathrm{csch}^{-1}$ |

| Russian | English |
|---|---|
| rot | curl |
| lg | log |

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# UTILIZATION OF MAGNETIC FIELDS DURING COLORING OF CELLULOSE AND POLYESTER FIBER FABRICS

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The intensification of the processes of coloring textile materials with the utilization of magnetic fields is executed by the magnetic treatment of industrial water or dye solution [1, 2]. Magnetization of water during coloring of cotton fabric by direct dyes [1] accomplished on the type PMU-1 apparatus with circular permanent magnets with laminar nature of flow, close to the transitional into the turbulent, and the strength of the magnetic field in the primary operating gap of the apparatus 143 kA/m [3].

The most effective variant of magnetic activation of thc impregnation process of cellulose and polyester fabrics with solutions of active and disperse colorants with their subsequent thermal fixation on textile material is revealed.

They subjected to magnetic treatment on laboratory equipment: I - the water, which proceeds to the preparation of solution; II - the dye solution before the supply into the saturating bath; III - the dye compound and textile material simultaneously in the impregnation process.

The diagram of magnetic treatment three versions is shown in Fig. 1, where 1 - batcher; 2 - mixing and metering device with a mixer; 3 - service tank; 4 - magnetic field; 5 - immersion machine with dye solution.

For the first two versions magnetization of liquids was conducted with a magnetic field strength of 160 kA/m and flow speed of 0.35 m/s. In the third version the magnet was placed into the saturating bath, which makes it possible to regulate the magnetic field

strength from 0 to 240 kA/m. A 24 s time of magnetic effect is selected as maximum for this laboratory device at the speed of motion of the textile material of 1 m/min. In the control version coloring of samples was carried out without a magnetic field.

Cotton calico cloth art.[art.-article] 15, Dacron art. 3201 and cotton-dacron art. 82192 served as the research subjects. The pigments used were: active violet 4K and red 5SKh, dispersed violet K and vivid-rose.

They impregnated the cloth at a temperature 25°C with a typical composition, which contains pigment and urea, and in the case of active pigments, sodium bicarbonate also, after which they wrung out up to 100% of the increase in weight. The dried out samples passed through heat treatment in a special cabinet drier at a temperature of 180°C for 90 s, then they were washed according to regulated regimes.

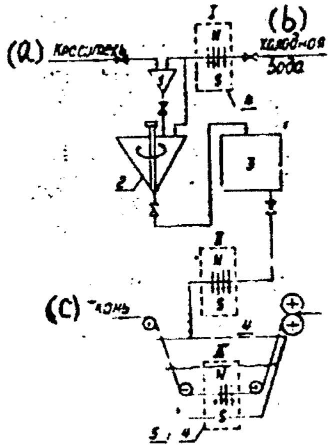


Fig. 1. Key: (a). Pigment. (b). Cold water. (c). Cloth.

Page 65

The quantity of pigment on the cloth was determined by colorimetric method on a laboratory photometer LMF-72 with an accuracy of ±2% with statistical reliability of 95% for ten parallel experiments. The results of coloring during the utilization of the different variants of the magnetic effect are given in table 1, whence it is possible to draw a

conclusion about the positive effect of magnetic activation during coloring of cotton and Dacron fabric with active and disperse colorants respectively.

**Table 1**

| (a) Краситель | (b) Варианты магнитной обработки* | (c) Содержание красителя на волокне, г/кг | | (d) Степень фиксации, % |
|---|---|---|---|---|
| | | (e) нанесенного | (f) фиксированного | |
| (g) Активный фиолетовый 4K | 0 | 14,5 | 10,1 | 69,7 |
| | I | 14,4 | 11,0 | 76,4 |
| | Ц | 15,7 | 12,3 | 78,3 |
| | III | 16,5 | 13,2 | 80,0 |
| (h) Активный красный 5CX | 0 | 15,9 | 8,0 | 50,3 |
| | I | 16,9 | 8,8 | 52,1 |
| | II | 17,0 | 9,3 | 54,7 |
| | III | 17,7 | 9,9 | 56,0 |
| (i) Дисперсный фиолетовый K | 0 | 13,7 | 10,9 | 79,6 |
| | I | 13,8 | 11,3 | 83,1 |
| | II | 14,0 | 12,0 | 86,0 |
| | III | 15,1 | 13,1 | 86,5 |
| (j) Дисперсный ярко-розовый | 0 | 14,4 | 10,6 | 73,6 |
| | I | 14,6 | 11,5 | 78,9 |
| | II | 14,6 | 11,7 | 80,1 |
| | III | 16,2 | 13,2 | 81,5 |

* 0 - kontrol version.

**Key: (a). Pigment. (b). Versions of magnetic treatment *. (c). Content of pigment on the fiber, g/kg. (d). Degree of fixation, %. (e). applied. (f). fixed. (g). Active violet 4K. (h). Active red 5SKh. (i). Dispersed violet K. (j). Dispersed vivid-rose.**

Utilization of magnetized water (version I) increases the degree of fixation of pigments by 4...6%, virtually without influencing their selectivity from the bath. In version II the sorption of active pigments is increased by 7...8% without essential effect on the selectivity of disperse colorants with an increase in the degree of fixation of active and disperse colorants by 5...8%. The third version shows an increase by 10...14% of selectivity of active and disperse colorants with a higher degree of fixation in comparison with the preceding versions.

An increase in the dyeability of textile materials is connected with the change of the structure of water systems at the moment of treatment. The life time of the new structure

depends on the flow speed of the liquid in the magnetic field, the holding time after magnetization and mechanical effects on the solution in the coloring process. A significant effect of the factors indicated is developed in versions I and II of magnetic treatment. During the utilization of the magnetized water or dye solution after holding for an hour an increase in the dyeability of cloths is not discovered, but after holding for 30-minutes the effect is has an unstable nature. The effectiveness of magnetic treatment is also reduced under intensive mechanical effects on the magnetized water system, for example, during the preparation of the coloring composition, filling of immersion bath and the passage of cloth through it.

Page 66

The reactivity of active pigments is increased under the effect of a magnetic field, which in the absence of cellulose fiber is evinced by the acceleration of hydrolysis. After holding for 30-minutes the hydrolized part of the active pigments in the preliminarily magnetized solutions in comparison with non-magnetized solutions for violet 4K was increased by 3...5%, for the red 5SKh by 35...40% with respect to one atom of chlorine and by 2...4% with respect to two atoms of chlorine.

The instability of the obtained effect, the complexity of control and controlling all factors, which influence the effectiveness of magnetic treatment, impede the industrial utilization of the magnetized water and magnetized dye solution for the intensification of the thermal fixation method of coloring cellulose and polyester fiber cloths.

The magnetic effect directly in the impregnation process of textile material makes it possible to decrease or to completely eliminate the effect of undesirable factors. In articular, the moment of solution activation coincides with the moment of its utilization. Structural changes in the dye solution to a lesser degree depend on mixing in the bath, the speed of motion of the liquid in the magnetic field is determined by the speed of the cloth guide, which is controlled and regulated on any dye equipment. An increase in the activity of pigments during the presence of the textile material, also activated by a magnetic field, is directed toward the reaction with the fiber, which decreases the speed of the hydrolysis of pigments and in turn leads to an increase in the sorption of pigments.

During magnetization of water or dye solution taking into account the effect of the factors in question a maximum increase of the yield of the pigments even under the most favorable conditions does not exceed 4...10% and 8...22%, respectively. Magnetic treatment directly in the impregnation process of cloth in the dye bath with the same field strength contributes to a stable increase in the dyeability of materials by 20...30%.

Thus, the approach of the magnetization operation on the impregnation of cloth with a dye solution to their coincidence is the necessary condition for the effective utilization of magnetic fields in the process of the thermal fixation method of coloring.

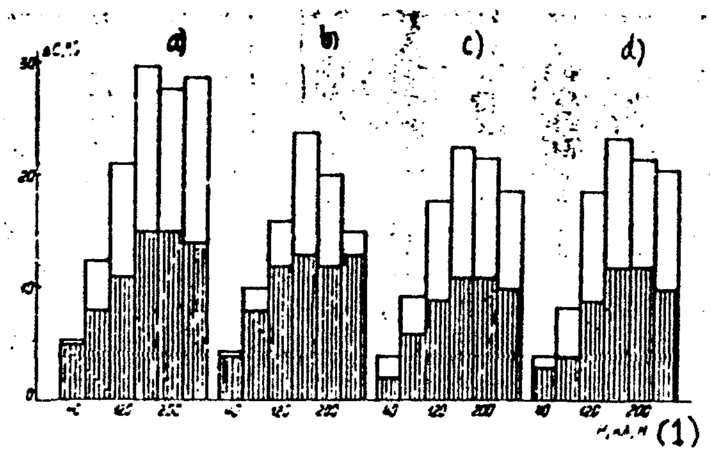


**Fig. 2. Key: (1). H, kA, m**

Page 67

For the purpose of the optimization of the regime of the magnetic effect, the effect of the intensity of the magnetic field is studied on the results of coloring. The relative increase (ΔC, %) quantity of applied (shaded area) and fixed (non-shaded area) pigments of active violet 4K (Fig. 2-a) and red 5SKh (Fig. 2-b), dispersed violet K (Fig. 2-c) and vivid-rose (Fig. 2-d) with different strengths (H, kA/m) of the magnetic field is given in Fig. 2.

The results attest to the fact that a stable increase in the dyeability of cotton and polyester fabric is provided in the interval of magnetic field strength of 120...240 kA/m. A

field strength of 160 kA/m is optimal, with which an increase in the quantity of fixed active and disperse colorants is maximum and makes up 22...30%.

The obtained dependence is retained also during coloring of the cotton-Dacron cloth: with an optimal magnetic field strength of 160 kA/m the yield of the active violet 4K on the cotton component is increased by 18%, and dispersed violet K on the polyester component by 23%.

## CONCLUSIONS

1. A method of simultaneous magnetization of the dye solution and the cellulose and polyester textile material is proposed and substantiated in the impregnation process for the intensification of thermal fixation coloring with active and disperse colorants.

2. A stable increase in the dyeability of cloths is provided in the interval of magnetic field strengths of 120...240 kA/m. The optimal magnetic field strength is 160 kA/m.

## REFERENCES


1. M. I. Davidzon, T. N. Mal'tseva. Textile Industry. 1982. No. 6. p. 17.
2. Patent 294891 USSR. A method of Dyeing Textile Materials, I. Ya. Kalontarov, P. M. Solozhenkin, N. A. Strunkina (USSR). Publ. 1971. Bull. No. 7.
3. V. I. Klassen. Magnetization of water systems. M.: Khimiya, 1982. p. 147.



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